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PAINTING EXTERIOR WALLS OF POROUS MASONRY

The extensive use of porous masonry products (cast concrete, brick, asbestos cement siding, and concrete, cinder and light-weight aggregate block) for exterior walls above grade, has increased the need for information concerning paints suitable for decorating and in some cases waterproofing these structures (see Note 1 on page 9). This letter circular is intended as a guide to the consumer in selecting the type of paint best suited to his needs and to give general directions regarding its use. In any instance where these directions vary from those supplied by the manufacturer, the manufacturer's recommendations should be given preference.

Paints for masonry wall surfaces may be divided in four classes: cement-water paint, resin emulsion paint, oil paint, and paint containing rubber in the vehicle. Whitewash, another commonly used coating for masonry, will be omitted because the National Lime Association, Washington, D. C., in their publication "Whitewash and Cold Water Paints", Bulletin 304D (available on request) treats the subject thoroughly, giving formulas, directions for application and suggested uses.

In selecting the type of paint to be used, some consideration should be given to the physical characteristics of the wall surface, such as relative moisture content and age, texture and porosity and, in the case of repainting, the type of coating previously applied. Cement-water paints are particularly suitable for application on walls which are damp at the time of painting or may become damp after painting as a result of structural defects, new structures (less than 6 months old) which normally contain water-soluble alkaline salts, and open-textured surfaces (for example cinder, concrete and light-weight aggregate block). Close-textured surfaces (cast concrete, asbestos-cement siding, tile, etc.) which are relatively dry may be painted with resin emulsion paint or paints containing rubber in the vehicle. Walls which are dry at the time of painting and are so constructed as to remain dry after painting may be decorated satisfactorily with oil paints.

The durability and ultimate satisfactoriness of the paint selected will depend to a large extent on the preparation of the wall surface and the application of the paint. Because of the difference in physical and chemical properties of the four types of paint, each type will be considered separately.

1. Cement-Water Paint

Cement-water paints are packaged in powder form and are composed chiefly of portland cement or portland cement and lime. The composition and physical requirements of a desirable paint of this kind are covered in Federal Specification TT-P-21 (see Note 2 on page 9). Many of the proprietary cement-water paints on the market conform to this specification. It should be noted, however, that the composition of the paint powder is secondary in importance to the condition of the painting surface, the method of application and the curing of the paint film as factors in determining the durability of the coating.

(a) Preparation of the Surface.- The minimum amount of surface preparation should consist of thoroughly removing all dirt, dust and efflorescence from the surface. Dirt and dust should be washed off with clean water. To remove efflorescence, first wet the masonry, then apply a 20-percent solution of muriatic acid and after about 5 minutes scrub off the salts with stiff bristle brushes. It is best to wash small areas. The surface must be thoroughly washed with clean water after an acid treatment.

Old coatings of whitewash and flaking or scaling cement-water paint should also be removed, using the acid treatment outlined for efflorescence.

Firmly adhering coatings of portland cement-water paint or cement-water paints which are "chalking" or "dusting" need not be removed. Brushing with a stiff brush is usually sufficient.

Old coatings of the organic type must be completely removed. Usually this can be done most effectively by sandblasting.

(b) Dampening the Masonry.- Before applying the paint the masonry should be thoroughly wetted to control the surface suction and to provide a reserve of moisture to aid in the proper hardening of the paint. A garden hose adjusted to give a fine spray is well suited for this purpose. A superficial dampening with a brush dipped into a bucket of water is wholly inadequate. Usually it is sufficient to wet the walls in one operation not more than an hour before painting. The spray should be applied in such a manner that each part is sprayed 3 or 4 times for about 10 seconds each, time being allowed between applications for the water to soak into the surface. If the surface tends to dry rapidly, as it may in hot weather, it should be redampened slightly just in advance of painting; it should be moist but not dripping wet or have a noticeable water film when the paint is applied.

(c) Mixing and Preparing the Paint.- Proprietary cement-water paints require only the addition of and mixing with water to prepare them for use. Generally it is better to purchase the mill-ground commercial product, and for those who wish to make the paint the following formulas for job-mixed paints have given satisfactory results both as to durability and appearance:

	<u>Parts by Weight</u>
(1) White portland cement	77
Hydrated lime ¹	15
Calcium stearate	1
Calcium chloride	4
Titanium dioxide or zinc sulfide	3
Aggregate (optional):	
White or light-colored silica sand (passing No. 20 sieve and not more than 15% passing the No. 100 sieve)	77
(2) White portland cement	70
Hydrated lime ¹	30
Aggregate (optional):	
White or light-colored silica sand (passing No. 20 sieve and not more than 15% passing the No. 100 sieve)	70
(3) White portland cement	2 parts by vol.
Aggregate (white or light-colored silica sand (passing No. 20 sieve and not more than 15% passing the No. 100 sieve))	1 part by vol.

¹ The total free (unhydrated) calcium oxide (CaO) and magnesium oxide (MgO) in the hydrated lime should not exceed 8 percent by weight of the hydrated lime.

The inclusion of aggregate in Formula 3 is recommended, especially for the first coat, for paint applied to coarse textured masonry, such as concrete or cinder block and open joint masonry.

Tinted paints may be made by adding suitable amounts of coloring pigments, but due to the difficulty of producing uniform colors by hand mixing it is suggested that tinted paints should be commercial brands which are mill ground in the factory.

In preparing the job-mixed paint the various dry constituents, including the coarse filler, should be thoroughly mixed together in the dry state. Small batches, 50 lbs. or less, may be mixed by stirring the material together in a tub, and then sifting this mixture 2 or 3 times through fly screen. The powder paint should be stored in moisture-proof containers until used.

When preparing a paint for use, the recommended procedure is first to reduce the dry material to a stiff paste by adding water in small portions, with constant stirring, after which additional water should be gradually stirred into the paste until the desired consistency is obtained. The proper amount of water will vary, depending upon the fineness of the dry materials, and should be determined by trial. The mixed paint should have the consistency of rich cream except that a slightly thinner consistency is recommended for the first coat applied to open textured types of concrete surfaces, such as concrete masonry units.

The paint should be vigorously stirred for several minutes until it is of uniform consistency and all particles are thoroughly wetted. Workability will be improved by allowing the mixture to stand 20 to 30 minutes with occasional stirring. Most paints remain in a usable condition for 3 or 4 hours after being prepared although in hot weather some paints, especially those containing calcium chloride, should be used within 3 hours.

While being used the paint usually tends to stiffen, due to chemical and physical reactions and evaporation of the water, and it is common practice to thin the paint with additional water when necessary to maintain the desired consistency. There seems to be no serious objection to retempering white paints, provided it is properly done. The paint should first be stirred vigorously as sometimes this operation will restore its fluidity. Any additional water required should be added in small increments and thoroughly incorporated.

(d) Application of Paint.- The surface should be uniformly damp but with no free water.

For obvious reasons, no painting should be done on frozen masonry or when the paint may be exposed to temperatures below 45° within 48 hours after application.

The paint should be applied in two coats. Preferably not less than 24 hours should be allowed between coats. The first coat should be slightly moistened with water before applying the second coat. "Doubling back" or the application of a double thick coat is not conducive to good results.

Most portland cement paints can not be satisfactorily applied with the ordinary hair bristle paint brush. Proper application requires a brush with relatively short, stiff fiber bristles such as fender brushes (commercially sold for cleaning the under side of automobile fenders), ordinary scrub brushes, or roofers brushes. Experiments indicate that when painting for the dual purpose of decorating and waterproofing both coats should be vigorously scrubbed on in such a manner as to work the paint back into the voids and provide a continuous paint film free from pinholes or other openings through which water might penetrate.

When weather conditions are such as to cause the paint to dry rapidly, it is advisable to work "in the shade" in so far as practicable.

(e) Curing of Paint Coat.- Proper hardening of paint films of this type depends upon the availability of moisture for chemical reaction with the portland cement. The moisture in the masonry walls, in the paint itself, and in the air is utilized for this purpose but usually this is not enough. In most cases it is practicable to sprinkle the painted surface two or three times a day with the same fog spray used for dampening the walls prior to painting, and it is recommended that this be done between coats and for 2 days after the final coat, starting as soon as the paint has set sufficiently not to be damaged by the spray, usually 6 to 12 hours after application. Damp curing in this way will improve the hardness and durability of the paint in every case and in some instances will mean the difference between a satisfactory and a poor paint job.

2. Resin Emulsion Paints

These paints are available in white and tints and consist of prime pigments ground in a vehicle of oil extended resin which has been treated with an emulsifying agent to render it miscible with water. A typical paint of this class is easy to apply by brush or spray and dries within a few hours to a smooth, opaque, flat finish.

Typical specifications covering this type of paint are Bureau of Yards and Docks, Navy Department Specification P5, "Paint, Camouflage, Resin-Emulsion, Paste"; and Civil Aeronautics Administration Specification CAA 577, "Paint; Alkyd Resin Emulsion, Exterior". (See Note 2).

(a) Preparation of the Surface.- Foreign material, such as dust, loose mortar, and flaking paint, should be removed by vigorously brushing with a wire brush. Old paint coatings remaining after this treatment need not be removed. Open-joint or coarse textured walls should first be given a base coat of cement and sand (see Section 1. (c), Formula 3), applied and cured as outlined in Section 1. This base coat should dry 96 hours before applying the resin emulsion paint. During very dry weather or on quite porous material, it is frequently advantageous to slightly dampen the wall with water in order to reduce suction. These paints may be applied satisfactorily to damp walls but should not be applied to wet walls.

(b) Application of the Paint.- Resin emulsion paints are usually packaged in paste form to be thinned before using with water in the approximate proportion of 2 parts of paste to 1 part of water. When manufacturer's directions are given they should be followed, since the paste paints of different companies may vary in consistency. If the paint is applied by spray, additional thinning may be necessary. However, the paint should

not be thinned to the point where more than two coats are needed to give adequate hiding. If the first coat is difficult to apply, (i.e. pulls under the brush), it is better to dampen the wall surface than to thin the paint excessively. The first coat will probably dry to touch within 4 to 6 hours but the paint should be allowed to dry overnight before applying the second coat.

3. Oil Paints

Oil paints designed for use on masonry are usually ready-mixed paints containing opaque pigments suspended in drying oils and thinner. They should be formulated so that the first coat seals the surface sufficiently to prevent spots or flashes of the second coat. Two coats are necessary for good hiding and durability. The chemical composition and physical characteristics of a satisfactory oil paint for masonry surfaces are specified in Federal Specification TT-P-24 (see Note 2).

It should again be mentioned that moisture back of the paint film will seriously impair the life of the coating -- therefore the application of oil paint to new masonry should be deferred until the walls have had time to dry. This may require 3 months to 1 year, depending on the thickness and porosity of the wall and weather conditions. It is equally important to prevent water from entering the walls subsequent to painting, hence the importance of repairing any structural defects such as leaks around flashing, doors and windows, and in the case of open textured surfaces the application of a cement-sand-base coat prior to painting.

(a) Preparation of the Surface.- Adequate preparation of the surface contributes to the durability and appearance of the paint coating. The minimum amount of surface preparation should consist of thoroughly removing all dirt, dust, form oil and efflorescence. Dirt and dust should be brushed off, using stiff fiber or wire brushes. To remove efflorescence first wet the surface, then apply a 20 percent solution of muriatic acid and after five minutes scour off the salt deposits with a stiff bristle brush. If necessary, a stronger acid concentration may be used. It is best to work on small areas, not more than four square feet. The surface must be thoroughly washed with an abundance of clean water after each acid treatment. It is practicable to remove traces of form oil with steel brushes, abrasive stones or a lye solution. However, if the surface is generally contaminated with oil, it will be more effective to lightly sandblast the area to be painted or postpone painting until the oil has been removed by the action of the weather.

Some concrete surfaces are so dense (glazed) as to make paint adhesion difficult to obtain. Concrete that is cast against plywood, Preswood, or steel forms frequently present such a problem. It is suggested that preparatory to painting, such surfaces be either acid washed, lightly sandblasted, or rubbed with coarse grit abrasive stones until the glaze is removed.

Old coatings of organic or cement-base water paint in sound condition need not be removed. Peeling, scaling, or flaking paints or whitewash should be completely removed.

On open textured masonry a cement-sand-base coat (Formula 3, Section 1. (c)) should be applied and cured as outlined in Section 1 (a), (b), (c), (d) and (e). This mix may also be used to fill faulty mortar joints or to obliterate map cracks in stucco or concrete. Large cracks in masonry walls should be cut to provide a channel with edges perpendicular to the surface or slightly undercut, and the opening filled with a mortar made by mixing 2 or 3 parts of mortar sand with one part of portland cement and enough water to give a putty-like consistency. To minimize shrinkage of the mortar after placement, the mortar should be mixed at least 1/2 hour before use. The surfaces to receive the mortar should be thoroughly wetted and then scrubbed with cement grout, and the mortar trowelled into place while the grout is still tacky. After the mortar has set it should be damp cured for at least 3 days.

A minimum of 90 days of good drying weather should elapse before applying oil paint over the cement-sand-base coat or mortar filled joints and cracks. When it is not practicable to wait 90 days before painting, a caulking compound rather than the cement mortar should be used as a crack filler.

(b) Application of the Paint.- Oil paints should not be applied during damp or humid weather or when the temperature is below 50° F. At least one week of clear dry weather should precede the application of the first coat. Since masonry surfaces tend to chill and collect condensed moisture, painting early in the morning and late afternoon should be avoided except in dry climates.

Manufacturers usually give directions for thinning, but in the absence of such directions the following may be used:

First Coat or Primer.-

- High grade masonry oil paint 1 gallon
- Spar varnish (non-reactive) 1/2 gal.
- Paint thinner (mineral spirits or turpentine) 1/4 gal.

Second Coat.-

Use paint as received or if too thick for satisfactory brushing add a small amount of thinner.

4. Paints Containing Synthetic Rubber

There are two types of these paints, the solution type in which the synthetic rubber is incorporated in a vehicle of treated drying oils, aromatic hydrocarbons and coal tar thinners, and pigmented with high hiding power, weather resistant pigments; and the emulsion type similar in composition to the resin emulsion paints except rubber replaces the resin in the vehicle. The rubber emulsion paints have poor package stability and until this is corrected, they will not be available for "over the counter" trade.

Service data on the performance of the rubber solution paints are inadequate but from the limited tests which have been made it appears that this material is promising as a decorative and alkali resistant coating for exterior masonry walls. It may be applied by brush or spray to dry or damp walls and dries quickly to a smooth, opaque, eggshell finish.

(a) Preparation of the Surface.- The procedure outlined in Section 3. (a) for removing dirt, dust, loose mortar, form oil, efflorescence and glaze (on dense surfaces) should be followed in preparing the surface for rubber paints. It is particularly important to remove the glaze so that the first coat can "strike in" the surface, otherwise poor adhesion usually results.

The cement-sand base coat (Formula 3, Section 1 (c)) offers an ideal surface for these paints and it is suggested that on open textured material the cement-sand coat be applied followed by two coats of the rubber paint.

Oil paint coatings must be removed before applying rubber paints, because the thinners used in these paints act as solvents in the oil paints.

(b) Application of the Paint.- Rubber paints may be applied to dry or damp walls. It is usually necessary to thin the paint for the first coat, using the thinner recommended by the manufacturer as some paint thinners are incompatible with these materials. The paint dries to touch within 3 hours but at least eighteen hours drying should be allowed between coats, otherwise the succeeding coat will "lift" or soften the undercoat.

The brushing technique used for applying enamels should be used for the rubber paints. "Back-brushing" or "working" the paint will cause it to roll and pull under the brush. As the paint tends to "set" rather quickly due to the evaporation rate of the thinners, it is advisable to work in the shade in so far as practicable.

Note 1. Information on waterproofing masonry walls is given in the following building materials and structure reports which are obtainable from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C., at price listed:

- BMS 7. Water Permeability of Masonry Walls - 10 cents
- BMS 76. Effect of Outdoor Exposure on the Water Permeability of Masonry Walls - 15 cents
- BMS 82. Water Permeability of Walls Built of Masonry Units - 20 cents
- BMS 94. Water Permeability and Weathering Resistance of Stucco-Faced, Gunite-Faced and "Knap Concrete Unit" Walls - 10 cents
- BMS 95. Tests of Cement-Water Paints and Other Waterproofings for Unit Masonry Walls - 15 cents

Note 2. Copies of Federal Specification TT-P-21, Paint, Cement-Water, Powder, White and Tints (for Interior and Exterior Use) and Federal Specification TT-P-24, Paint; Concrete and Masonry, Exterior, Eggshell Finish, Ready-Mixed, White and Tints, may be obtained from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. Price 5 cents each.

Copies of specifications (P5) from the Bureau of Yards and Docks, may be requested from the Bureau of Yards and Docks, Navy Department, Washington, D. C.

Copies of the Civil Aeronautics Specification (CAA 577) may be obtained from Civil Aeronautics Administration, Office of Federal Airways, Washington, D. C.

